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STRATEGY FOR PRODUCTION OF RAILS, SLEEPERS, AND OTHER STEEL MATERIALS FOR THE RAILWAYS, WITHIN THE FRAME OF DEVELOPMENT OF THE IRON AND STEEL INDUSTRY IN AFRICA*

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I N D E X

		Pages
1.	Introduction	2
2.	Evaluation of Activities and Future Prospects of UAR	4
2.1.	Present Activites	5
2.2.	Prospects	5
2.3.	Statistics	6
3.	Status and development of the iron and steel industry in Africa	9
3.1.	Iron and Steel Industry - The World Setting	9
3.2.	The Iron and Steel Industry in Africa	14
4.	Recommendations for Action for the Development of the Iron and Steel Industry in Africa, in Interconnection with the Development of the African Railways	24
5.	Conclusions and Recommendations	31
ANNEX 1 -	1. Tracks	34 - 36
	3. Rolling Stock	37 - 43
ANNEX 2 -	Mineral Resources of Africa/Production, 1980	44
	- Iron and Steel Industry in the African countries	45

1. INTRODUCTION

In its resolution 32/160 the United Nations General Assembly proclaimed the Transport and Communications Decade for Africa, 1978 - 1988. The assistance to the African railway engineering sector is one of the most urgent priorities of the Decade due to its direct relationship to the overall economic and social problems confronting African countries.

The density of the African railways network is very low. For 29 million km^2, the African continent has only 80,706 km of track which gives an average density of 2,63 km per 1,000 km^2; while in Europe, with other highly developed modes of transport, it is over 60 km per 1,000 km^2. On the African continent 10 countires have no national railways or section of an international railway. These are the Gambia, Niger, Somalia, Chad, Rwanda, Burundi, the Central African Republic, the Libyan Arab Jamahiriya, Lesotho, Guinea-Bissau and Equatorial Guinea.

The African railway network is made up of a series of secondary network most of which being national in character and often independent. Moreover, they do not all have the same technical characteristics. There are nine gauges in Africa but only three are widespread, namely, a normal European track gauge 1,435 m for 11,743 km (14,5 percent), a standard African track gauge 1,067 m for 49,473 km (61,3 percent) and a metric track gauge 1,000 m for 15,472 km (19,2 percent).

The normal European gauge is used in North Africa from Morocco to Egypt. The standard African track gauge is that of the South African countries' network including Zaire, Sudan, Ghana, and Nigeria. The metric track gauge is that of the railways of West Africa and East Africa. The adoption of 1,067 m as the standard gauge for the entire continent would facilitate the inter-connection of the networks, the unification, development and improvement of railway services and facilities for the production and maintenance of railway equipment.

So far, investigations have not been made on the development of the African Railways and railways industries, vis-a-vis development of the iron and steel industry on the continent, and the mutual requirements and existing constraints imposed along both lines of development. Therefore, the initiative of the UAR is very timely and suggestive, and the elaboration on this subject would be useful both for the railways and the iron and steel industries development in Africa.

In the Resolution on the Lagos Plan of Action, the Member States have recognized that transport and communications constitute a most important sector on whose development depends not only growth sector but also the socio-economic integration of Africa, as well as the promotion of intra- and extra-African trade.

In recognition of the special importance of the transport and communications sector to the African economy, the Economic Commission for Africa Conference of Ministers in March 1977 has adopted a resolution calling for the declaration of a Decade for Transport and Communications. This resolution has been endorsed first by the Economic and Social Council and secondly by the General Assembly of the United Nations which has accordingly proclaimed the Transport and Communications Decade for Africa, 1978 - 1988. This resolution has been subsequently adopted by the OAU of Heads of States and Government in Monrovia in July 1979.

On the above mentioned summit fora, the principal goals of the strategy for the decade defined by the ECA Conference of Ministers of Transport, Communications and Planning in May 1979, have been endorsed and the Member States have agreed to work towards:

(a) promotion of the integration of transport and communications infrastructures with a view to increasing intra-African trade;

(b) ensuring the co-ordination of the various transport systems in order to increase their efficiency;

(c) opening up of the land-locked countries and isolated regions;

(d) harmonization of national regulations and reduction to a minimum of physical and non-physical barriers with the aim of facilitating the movement of persons and goods;

(e) stimulating the use of local human and material resources, the standardization of networks and of equipment, research and dissemination of techniques adapted to the African context in the building of transport and communication infrastructures.

(f) promotion of industry in the field of transport and communication equipment, and

(g) mobilization of technical and financial resources during the decade, with a view to promoting the development and modernization of transport and communication infrastructures in Africa.

These goals have to be realised through the implementation of projects classified in accordance with their relevance in meeting the problems of transport and communications in Africa as follows:

(a) (i) regional projects;
(ii) sub-regional projects;
(iii) national projects with a regional or sub-regional impact.

(b) projects for the least developed, land-locked, newly independent, island and frontline and other majority ruled countries in Southern Africa.

(c) projects of concern to other countries.

It has been decided to implement the Decade in two phases:

PHASE I : 1980 to 1983

- continued implementation of ongoing projects;
- implementation of projects already identified and studies and which are only waiting to be financed;
- identification of technical feasibility and economic studies of other projects and a search for their financing.

PHASE II: 1984 to 1988

- continued implementation of projects undertaken in the course of the first phase;
- financing and implementation of new projects;
- continuation and identification of other new projects.

2. EVALUATION OF ACTIVITIES AND FUTURE PROSPECTS OF UAR:

The establishment of the UAR in 1974 was in response to the desire of the African countries to make railways play their full role in the economic development of the continent in view of the technical and economic advantages of this mode of land transport:

- heavy traffic over long distances;
- low energy consumption;
- generation of economic activity.

2.1. Present Activities

In 1976, the 4th General Assembly of UAR approved the short and medium-term programme of action. This programme is currently at various stages of execution, and comprises:

(a) Railway interconnections:
- Master plan for rail links in Africa (26,000 km long);
- the transport decade and the railway (1978 to 1988);
- normalization and standardization of stock and equipment.

(b) creation of sub-regional training centres;
(c) UAR Documentation and Publication Centre;
(d) sub-regional grouping of purchases;
(e) organization of railway meetings;
(f) establishment of relevant Working Committees.

2.2. Prospects

The UAR pursued its policy of co-operation with the different sub-regional agencies with a view to favouring the development of railway industries in Africa. Within this specific framework, the West African Economic Community (CEAO) has entrusted the UAR with conducting a feasibility study for a community wagen factory in the West Africa sub-region. This feasibility study will be followed by a study on execution in accordance with the CEAO's three year investment programme. This experiment is to be encouraged for obvious economic reasons, and because the construction of wagons does not demand an advance technique which African technicians and engineers have not yet mastered. The UAR will examine the possibility of setting up in each sub-region the following units:

(a) sleeper production units (wood - concrete and metal);
(b) industrial ballast production units;
(c) depending on the railways geographical situation the UAR will stimulate and encourage experiments in the use of solar energy for signalling, so as to countervail the constraints of traditional sources of energy;
(d) grouping of purchases;
(e) creation of Railway Documentation Centre;
(f) creation of sub-regional Training Centres;
(g) improvement of railway operating conditions.

2.3. Statistics

(1) There are three gauges, the so called standard gauge (1.435 m) is found in North Africa and in Gabon - where a new railway is under construction. The so called metric gauge (1.067 m) is found in East and Southern Africa and the (1.000 m) metric gauge is gernerally found in West and central Africa. Lines with gauges of less than (1.000 m) are in the process of being replaced.

(2) Africa today has approximately 100,000 Km of railway lines. Most of these lines were built prior to the 1950's. The use of electric traction (2,000 Km of electrified lines) is not yet wide spread, it is currently used by only 4 or 5 countries (Algeria, Egypt, Morocco, Zaire, Zimbabwe).

(3) The average speed of train is still quite low, 30 Km/h for goods trains and 45 Km/h for passenger trains. These low-average result from the uneven geometry of tracks dating from over 50 years ago .

(4) Mining transport is the largest form of traffic, such minerals are intended exclusively for export. Traffic involving agricultural products ranks second. Passenger traffic is fairly developed in the countries of North Africa. The Egyptian railways carry over 25 million passengers annually. Efforts are being made by other countries to develop such traffic .

(5) The economic doldrums which the world as a whole is experiencing makes the operation of the African railways increasingly difficult. Financing for the renovation of rolling stock and the modernization of old lines is growing rarer or is granted under unfavourable conditions. In any even, operating results reveal a very serious deficit, some railways only survive owing to government subsidies .

(6) Despite these difficulties, and relatively unfavourable economic situation, railways, which generaly emerge in most countries as the backbone of the entire transport system, continue to wage the battle for economic development with a view to the integration of all the African economies .

(7) The following table shows the statistics which was carried by UAR in 1979 about the total length of the lines and the rolling stock in the subregion of Africa .

	Length of Line	No. of Coaches	No. of Wagons	Remark
North Africa	16101	195616	49775	
East "	9221	42093	23790	
West "	9873	47154	11250	
Central "	10387	16535	9598	
Total 1979	45582	301398	94413	
Total in 1984	50000	5000	100000	round figures putting in consideration the increase in the next 5 years.

From the above statistics we can estimate the requirements of the African Railways as follows :

(a) <u>Rails : Sleepers</u>

1. Renovation of tracks to meet present - day demands .

   This include about 25,000 km of rails and the necessary amount of sleepers .

2. Layout about 26,000 km of new railway lines to fulfil the master plan for connecting the African countries .

(b) **Rolling stock steel materials and casting**

1. The steel sections profiles, plates, sheets neede for renovation of the coaches and wagons which estimated to be 5000 coaches and 100,000 wagons .
2. The steel material needed for fabricating additional amount of coaches and wagons for meeting the increase in demand and for the new railways lines .

(c) From the above statistics we can estimate that the African railways requirement from steel materials (rails, sleepers, construction steel and steel semi fabricates for the new system and the repair and maintenance of the existing one, to be from 3 - 4 million ton yearly.

3. Status and development of the iron and steel industry in Africa

A survey of any industry ought to be done appropriately in the context of its world setting. This stipulation is equally if not more important in the case of a heavily capital intensive industry such as the iron and steel industry. It will be, therefore, necessary to outline in general the world's iron and steel industry, followed by a survey of the iron and steel industry in developing countries (Africa, Arab Countries, etc.) and by referring to UNIDO's technical assistance activities in the field of iron and steel industry for the developing countries and regions.

A survey of the iron and steel industry, national, regional or inter-regional is inevitably linked up with its future plans and the possibilities of their implementation; it is in the latter fields that constraints, obvious or oblivious, crop up in the case of developing countries with their limitations of scarce capital, scanty trained manpower and an extant or lean technological base.

3.1. IRON AND STEEL INDUSTRY - THE WORLD SETTING

The world production of crude steel has more than doubled in the last thirteen years, from 346 m tons in 1960 to 870 m tons in 1983. The growth rate of course was with regard to the individual steel producing countries not equal. Japan's share in the global growth rate was extraordinary. The big question for the future is: What about the growth rate of the steel industry in the developing countries. It is said that steel consumption is somewhat characteristic of the standard of living in a country. In this light the world still lacks a lot of steel. At present, Sweden has one of the highest per capita consumption of 700 kg, closely followed by the United States, then inter alia, by Great Britain with a per capita consumption of 400 kg; and then tail the numerous developing countries where the per capita rate is only a few kilograms of the decimal of a kg. If the developing countries increase their consumption only by a few kilograms per head, the quantities of additionally required crude steel would rise enormously.

The iron and steel industry is notably capital-intensive, with a specific requirement of $400-600[1/] for each ton per year of steel-ingot production capacity. In addition, in certain cases, particularly in developed countries, substantial infrastructure investment has to be made. Accordingly, the establishment of an integrated iron and steel plant with a capacity of 1 million tons per year of ingots will require an investment

1/ This figure is now approaching a $1,000 mark.

of $400 million to $600 million. Additional investment "upstream", i.e. for supply of the necessary inputs, and "downstream", i.e. for processing of steel into manufactured products, will have to be considered in addition and may amount to investments of the same order of magnitude. A large portion of the capital invested in iron and steel installations correspond to heavy industrial equipment and heavy industrial construction. The iron and steel industry is, thus, a large buyer of heavy capital goods. For developing countries this may mean a heavy burden on their balance of payments.

World steel output is expected to keep growing in the future as in the past because steel is one of the most basic industrial material. This long term growth seems assured, if only because the drive to industrialise will relentlessly augment steel demand in many emerging nations. But the uptrend will continue to mask profound changes in the pattern of world consumption and production of steel.

Over the past 100 years, the rise in the world's output of steel has been spectacular. In 1870, it was just short of 10 million metric tons. A half-century later, in 1920, it had increased nearly eightfold to 75 million metric tons. By 1983 it had climbed to 870 million metric tons.

As a nation starts to industrialize, a first surge of steel demand is likely to reflect heavy investment in its economy's infrastructure - the development of a transportation and communications network, electric-power generation and distribution, and other essential facilities. A broader impetus to steel consumption comes from the industrial expansion itself, which is both a cause and a prime beneficiary of the infrastructure improvement. As economic growth takes off and affluence starts to spread, demand escalates for key consumer durables such as cars and major appliances - which in turn, boosts the use of steel.

The country's demand for steel is likely to be satisfied at first by imports. But as its requirements increase, it will attempt to shift to domestic production - initially, perhaps only for large-volume items. The establishment of a domestic steel industry will be recommended increasingly on grounds that it will stimulate supplier and use industries, provide employment and save scarce foreign exchange. It will seem attractive, too, for reasons of self-sufficiency and defence - and at times because of the prestige surrounding steel mills.

The prospects, both immediate and long-term, of the steel industry are intimately linked with the world trade in steel. A good part of the world steel production is exported. For instance, in 1955, almost 13 percent of the world steel production was exported. Today, close to 23 percent of the world production is exported. Japan, the largest quantum exporter exported almost 37 percent of its production, followed by West Germany. Belgium exports more than three fifths of its production plus imports. Italy, France, Luxembourgh and Czechoslovakia also export quite a substantial portion of their production.

World trade in steel has greatly increased over a period of time. The rising trade has been engineered by Japan. The planned manner in which the top six steel producers in Japan have been pushing their steel everywhere, especially in West Europe and the US, has upset the steel production programmes in several of these countries.

One does not have to seek far for the reasons for the Japanese surge in exports. The unit costs of production in Japan is still about 40 percent of that in the US, 45 percent of that in West Germany and 60 to 65 percent of that in France, and these figures Japan is steadily still improving upon. Japan, having joined the steel producing countries' group more recently than all the other developed countries, has more up-to-date, scientifically advanced and technologically superior machinery.

In 1977, it took US steel producers some 15 man-hours to produce a tonne of steel. In 1974, it took them 11 man-hours for the same job. West Germany spent almost 37 man-hours in 1955 but only 20 man-hours in 1974. In the case of France, the man-hours spent for producing a tonne of steel came down from 35 hours to 26 hours. But the productivity of steel makers in Britain during 1974 remained almost at the same level of 35 hours. However, in the case of Japan, the man-hours needed to produce a tonne of steel came down sharply from 69 in 1955 to 9 in 1974! This alone is enough to demonstrate why Japan has forged ahead so fast while countries like the UK have remained where they were two decades ago.

The big exporters are aware that the W.Asian and African developing countries, moving towards higher economic levels, will continue to provide a boost to the production of steel in exporting countries. As the gestation period is pretty long before steel plants come into production, countries in Latin America, Africa and W.Asia will continue to demand steel.

The growth of the Third World steel industries is another structural effect and is an important factor to be reckoned when discussing world steel production.

Western World Steel Production in 1985, UNIDO Forecast 1/

	1974 m.tons	%	1985 m.tons	%	1974-1985 growth rate
Industrialized countries	462	93	613	83	2.6
Developing countries	36	7	125	17	12.0
Total Western World	498	100	738	100	3.6

Most of the Third World steel producers will be state-owned and export-oriented. Governments of the industrialized countries will try to assist the Third World development with a cut of the big steel markets. This will necessitate established exporters to restrict their share of certain major markets so as to accept Third World producers' participation.

World steel demand will grow at a much slower rate than before and production will match demand. The production pattern will transform with a shift from the industrialized countries to the developing world.

Already occuring is a diversification by the private sector into other related industries and into more sophisticated products and technologies.

Since the Fifties there has been much technological development in the steel industry. The locational problem has been idely studied for reduction in construction costs, operating costs, and, above all, pollution control. Bigger units are favoured for savings in capital cost and operating cost per tonne. The following tabulations are presented to indicate the investment made, capital costs of selected major steel works. The size of the blast furnace of Fukuyama grows with every stage of expansion.

	Inner Vol.of B.F. Cu.m.
Stage 1	2004
Stage 2	2828
Stage 3	3016
Stage 4	4197
Stage 5	4400

1/ Summary extract from IISI 68th Annual Meeting

The average investment pattern during 1971-75 in the four main steel making countries reflects the pattern of huge capital requirement of the industry.

		Capacity Mty.	M.$ investment
1.	USA	150	1850
2.	Japan	144	2880
3.	W.Germany	63	774
4.	France	34	860

Investment costs of selcted major steelworks are shown below:

Country	USA	Japan	France	Japan	Japan
Company	Bethlehem	Kobe	Usinor	NSC	NKK
Works	Burns Hbr.	Kakogawa	Dunkerque	Oita	Fukuyama
Cap.Mtpa	4.0	6.0	8.0	8.0	16.0
When Built	1964-75	1968-73	1960-74	1971-76	1963-73
Actual Cost	$ 1½ bill.	$ 1½ bill.	$ 1.1 bill.	$ 2 bill.	$ 2 bill.
Poss.1976 Cost	$ 3½ bill.	$ 3½ bill.	$ 5½ bill.	$ 4 bill.	$ 8 bill.

Brief analysis of the situation of developing countries in regard to Iron and Steel production and consumption

The situation of developing countries can be summarized as follows:

(a) Developing countries have increased their share of world production of raw steel (ingots) from 1.5 percent in 1950 to about 11 percent in 1983;

(b) In 1983, their share of world production was roughly 104 megatons, or 11 percent, while their share of consumption was roughly 128 megatons, or 15 percent;

(c) Their per capita production and consumption (as a whole) are extremely low, about 20 to 30 kilograms, respectively;

(d) Even the most developed of the developing countries show per capita indices much lower than developed countries, i.e. about 100 kilograms and 400-600 kilograms respectively;

(e) Only a few (about 13) developing countries in Africa, Asia and Latin America have established integrated iron and steel plants, however small;

(f) The iron and steel production of developing countries has grown at about 10 percent per year since 1950, with apparent consumption growing at about 8 percent per year;

(g) Developing countries still depend on imports for about one third of their needs for steel, about 35 megatons per year;

(h) Developing countries are heavy exporters of raw materials to developed countries. They supply about 125 megatons per year, or 19 percent of all iron ore consumed in the iron and steel industry (compare that with their share of 11 percent of world steel production). Since the ore they export is of a very high grade, their ore output represents about 25 percent of the iron contained in the world ore output;

(i) Many developing countries are now engaged in major efforts to plan, establish or expand their steel industry, which is generally considered a high priority sector;

(j) The degree of self-sufficiency (percentage of demand covered by local production) attained in the last few years is roughly estimated as follows: 73 percent for Latin America; 56 percent for Asia; 12 percent for the Middle East; 7 percent for Africa.

3.2. THE IRON AND STEEL INDUSTRY IN AFRICA

The current per capita steel consumption in Africa is one of the lowest in the world estimated at 8 kg compared to 250 to 300 kg on an average in developed countries. The consumption of steel in Africa primarily relates to steel rods (RCC), bare, light merchant mill sections, wire rods, rails, plates and sheets. It is currently projected to rise at an annual rate of growth of 9-10 percent. This means that the total steel consumption in Africa will exceed 60 million tons by the year 2000. This, however, is considered to be a pessimistic projection. The growth rate is relatively low for countries at an early stage of development but it is more than adequate for the establishment of iron and steel industry in each of the African countries and the sub-regions. Economies of scale should be taken into account; the production facilities should, therefore, be based on a sub-regional basis with phasing of projected steel industry's development. If this co-ordination materializes, the pace of development will rise and so will the steel consumption which may as a result rise to 3 times the above figure to give a total of 180 million tons by the year 2000. In some African countries, there are abundant reserves of high grade iron ores, oil and natural gas.

Charcoal can be considered for iron smelting in countries which lack coal resources but possess good forests and forestry development programmes. The annual capacity of operational iron and steel plants in African member countries of the Organization of African Unity is now much less than two

million tons; this capacity is expected to rise 15 million tons of steel by 1985. Compare this with the world picture around 1950, the total annual steel production in developing countries was less than three million tons; mid-fifties one often heard that the world's steel industry's capacity had reached saturation levels and that the developing countries could, therefore, import their entire steel requirements from the advanced steel producing countries and further that the developing countries should not enter into the highly capital intensive and the highly technological fields of the steel industry which was stated to be beyond their means financially and technically. However, by 1970, the annual steel production capacity of the developing countries attained a figure of 27 million tons. The phenomenal increase in world annual crude steel capacity from the World War II figure of 180 million tons and 200 million tons in the immediate post-war years to its present output exceeding 860 million tons annual production represents the gigantic growth of world iron and steel industry.

What are the steel production figures for Africa? Extremely low, and the following figures for the whole of Africa speak for themselves:

Steel production in Africa (x 1000 tons)

Africa	1964	1966	1968	1970	1973	1981	1983	1984 E
	3,269	3,503	4,312	5,346	6,405	10,860	11,850	11,970

The growth of Steel Consumption and local production in Africa during 1950-1982 at a compound rate (percent per annum) has been estimated at 5.95 and 9.78 respectively. The percentage of regional steel consumption covered by regional production over 1950-1982 for Africa is derived to give a figure of 3 for 1950, 5 for 1960 and 1965, 8 for 1970 and 6 for 1972, and 11 for 1982.

In terms of population, only five countries, namely Ethiopia, Zaire, Gambia, Uganda and Tanzania have a population of more than ten million each; only two African countries have a steel consumption level of more than 100,000 tons and five African countries more than 50,000 tons per year.

In Central Africa, only Zaire has a moderate steel consumption to justify a small scale steel plant based on local raw materials. Gabon's steel consumption currently is of the order of 80,000 tpy. Ethiopia, with a population of 26 million has a large market for steel but hardly any production. Kenya is building up his industries and steel consumption is growing. Zambia, with a population of 4.5 million has its northern part somewhat industrialized where copper industry is operating and its steel consumption is rising.

In West African countries, there is no steel production except small plants in Ghana and Nigeria that are scrap-based with small merchant steel rolling mills. Steel consumption in Nigeria has currently been of the order of 650,000 tons/year followed by Ivory Coast with a steel consumption exceeding 100,000 tpy. In Nigeria, plans are under implementation for the establishment of an integrated iron and steel plant, using the Direct reduction sponge iron-electric arc furnace route. It would produce 0.5 million tons/year of sponge for export and 0.5 million tons of semis for home market; natural gas will be used for sponge making. This project will reportedly have the collaboration of C. Itoh (Japan) for marketing/financing and of Korf (FRG) for technology.

An agreement has been signed several years ago by the Government of Zaire and FINSIIER (Italy) for the latter's collaboration in the management of the Société Nationale de Siderurgie at Maliku during the first ten years of operation; this plant has a capacity of 120,000 tons per year. In Egypt, identical developments are taking place at the present time.

The Egyptian General Organization for metallurgical Industries (EGOMI) has prepared a comprehensive and long-range plan for the utilization of mineral resources for iron and steel industry in the Arab Republic of Egypt, aiming to meet the increasing demand for the iron and steel products till 1985. The Helwan Steel complex, the only integrated steel plant in the country, has recently expanded its initial crude steel capacity of about 300,000 tpy to about 1.5 million pty in two phases (each phase based on an addition of 0.6 million tpy capacity); this expansion has been carried out with Soviet technical assistance. Other units of the steel industry in ARE are based on the melting of steel scrap in electric arc furnaces and basic open hearth furnaces (all cold charge); these plants have captive merchant steel rolling mills and steel foundries. The total capacity of the non-integrated small plants, viz. Delta Steel, the Egyptian Copper Works and the National Metal Industries Co., is of the order of about 300,000 tpy of liquid steel.

Non-integrated small steel plants in Egypt using cold charges consisting of steel scrap/pig iron, are equipped with basic open hearth and electric arc furnaces. At the Delta Steel, alloy and tool steels are mainly produced whilst the other plants mainly produce plain carbon mild steels for rolling into rods (Reo) bars, etc.

Ghana has a small plant based on electric arc furnaces. Ivory Coast has large reserves of low grade iron ore only.

In Liberia, the demand for iron and steel has risen sharply in recent years. In 1967, UNIDO had sponsored a detailed study of the iron and steel industry situation in Liberia; the latter has highly developed its iron ore mining and pelletizing industries.

Crude steel production in some of the Afro-Arab countries is shown below (x 1000 tons/y):

	1970	1974	1981	1983	1984E
Algeria	330	410	2,030	2,060	2,060
Tunisia	60	90	200	200	200
ARE	300	270	1,860	1,890	1,890
Libya			20	20	20
Total	690	770	4,110	4,170	4,170

Afro-Arab countries with a population exceeding 15 million, are: ARE, Morocco, Algeria and Sudan; total crude steel consumption in all these countries has been of the order of five million tons currently. Algeria is an agrarian country with good petroleum industry. Potential reseves of iron ore are also high and it has fully integrated steel plants in the country (El Hajdar) - plans which have raised Algerian steel production considerably in trhe last several years. Mauritania has good reserves of high grade iron ore but no steel industry.

Average Chemical Analysis of high-grade lumpy iron ores/concentrates/ pellets of selected African countries 1/

Lumpy Ore	Fe	SiO_2	Al_2O_3	CaO	P	S	Mn
			percent				
Algeria	52.56	2-6	0.6-1.5	1.8	0.01-0.03	-	0.2-1.6
Gabon	64.8	1.7	2.0	7.0	0.15	-	-
Liberia	65.8	2.5	1.0	-	0.05	0.005	-
Mauritania	65.0	4.3	1.2	0.2	0.03	0.01	0.12
High-grade concentrate (ore fines)							
Liberia fines	65.1	4.5	1.24	-	0.09	0.10	-
Liberia fines concentrate	64.4	5.3	0.51	-	0.037	0.022	-
Mauritania fines	62.7	7.2	1.6	-	0.018	0.002	-
Pellets - high-grade							
							MgO
Liberia	64.5	4.2	2.0	1.1	0.06	0.003	0.06
Morocco	65.5	2.6	1.2	0.8	0.006	0.008	0.97

1/ World Market for Iron Ores, UN New York, 1968 and Metal Bulletin 1969.

It will now be relevant to furnish some data concerning the capital and production costs of steel on an average basis under overall African conditions. Steel production costs through various process routes applicable to African conditions and raw materials are furnished in the following tables assuming reasonable unit costs and norms; these will provide the general trends on the subject.

Average Chemical Analyses of Raw Materials (percent)

%	Fe	SiO_2	Al_2O_3	CaO	MgO	S	F.C.	Ash
Iron ore pellets	65	2.4	1.5	-	-	-	-	-
Iron ore lumps	52	7.0	3.5	1.8	0.4	-	-	-
Blast furnace limestone	-	3.5	0.6	50.0	1.0	-	-	-
Dolomite	1.4	1.8	1.0	31.0	19.0	-	-	-
Coke	1.0	4.0	2.9	0.3	0.2	1.0	89	10

Unit Costs (latest price US$ per ton)

Iron ore pellets	65% Fe	28
Iron ore lump	52% Fe	19
Iron ore fines	52% Fe	10
Manganese ore (high-grade)		65
Limestone/dolomite		7
Fluorspar		120
Blast furnace coke		100
Nut coke		50
Fe Mn		450
Fe Si		400
Natural gas 10^6 Koal		1.0
Power KWh		0.1

Estimates of production costs by different process routes (average approximations)[1/]

	Direct Reduction HyL gaseous process and electric furnace			Sub-merged arc electric smelting of pig iron and LD oxygen steel-making		Blast furnace LD oxygen steel-making	
Liquid steel production x 1000 t/year	300	1,000	2,000	3,000	600	1,000	2,000
Capital cost US$ per annual ton liquid steel capacity	100	86	80	150	135	119	109
Production cost US$/ton							
Sponge iron	39	37	35	-	-	-	-
Hot metal	-	-	-	78	77	70	68
Liquid steel	70	69	67	99	96	87	84
Fixed charges US$/ton[2/]	10	8.5	8.0	15	14	11	10.0
Total cost of production of liquid steel - US$/ton	80	77.5	75	114	110	98	94

[1/] These estimates do not relate to any particular African country but provide approximate averages which vary from one African country to the other.

[2/] Fixed charges are based on the following:

- Interest on capital at 4.5% on 50% of the capital
- 5% depreciation
- Interest on working capital for three months production cost at 6.5%
- Total fixed charges are calculated adding 30% to the capital costs to cover infrastructure facilities (raw materials handling transport, etc.)

Reserves of African Iron Ores[1/]

Fe % range	Proved reserves million tons	Potential reserves (unproved) million t	Total 1 + 2 million tons
30 - 67	6,800	24,500	31,300

Grades of Iron Ores in Selected African Countries

Country	Reserves mill. tons	Fe%	SiO_2%	Al_2O_3%	Mn%	P%	S%	Others %
Mauritania	465	65.0	4-3	1.2	0.12	0.03	0.01	-
Morocco	149	60.0	7			0.05	1.5	14.6 BaO
		43.0	9.6	1.2	2.3	0.01	-	2.2 CaO
		52.2	8	5.9	0.2	1.04	0.03	
Algeria	1,579	40.0-56	3.8	-	2.0	-	0.5	3.4 CaO + 1.0 NgO
		49-54	4.9	4.3	-	0.8	-	0.3 MgO + 0.3 Ti
Tunisia	75	54.0	4.0	0.8	2.1	0.03		0.5 CaO
		58.0	4.0	3.7	2.0	0.10		0.3 CaO
Libya	3,525	49.0	10.9	4.9	-	0.94	-	-
		50.5	7.05	4.6	-	1.03		
		51.75	6.15	4.9	-	0.92	-	-
ARE	433	46.9	14.10	NA	2-4.5	0.6-1.0	NA	
		49-59	2.6-9.1		NA	0.19-0.6		
		43	20-25	NA	NA	NA	NA	
Sudan	61	37-61	NA	NA	NA	NA	NA	NA

[1/] World Reserves of Iron Ores, United Nations, 1970

Oil and gas resources of Africa - 1973 1/

Country	Oil million cu m	Gas billion cu m
Algeria	7,550.00	2,960.00
Angola (incl.Cabinda)	192.00	28.40
Congo (Bras.)	800.00	
Dahomey	832.00	213.00
ARE	100.00	
Gabon	176.00	198.00
Libya	4,864.00	781.00
Morocco	160.00	40.00
Nigeria	2,400.00	1,136.00
Tunisia	160.00	28.40
Zaire	80.00	
TOTAL	17,314.00	5,304,80

As of 1 January 1974, Africa's (Algeria, Angola, Congo, ARE, Gabon, Libya, Morocco, Nigeria, Tunisia and Zaire) crude oil and natural gas reserves have been estimated at 10,701.34 million cu m and 5,315.59 billion cu m, respectively.

Estimates of natural gas flared in some African countries - billion m^3 - 2/

Country	1965 produced	1965 quantity flared	1965 proport.	1975 (estimates) produced	1975 (estimates) quantity flared	1975 (estimates) proport.
Algeria	3.97	2.10	53%	11.33	2.27	20%
Libya	8.61	8.61	100%	17.85	12.24	70%
ARE	0.31	0.25	84%	2.83	1.42	50%

1/ Oil Statistics - Government of India, Jan.-March 1973, Petroleum Information Service, New Delhi

2/ Development and utilization of natural gas resources and their vital role in accelerating economic development by Abdel Dayan A. El-Sani, Planning and Development Adviser, Kuwait.

The existing capacities of the iron and steel industry in Egypt, as well as the planned expansion with regard to the requirements of the African railways, are shown below.

PRODUCTION CAPACITIES OF EGYPT

(Sections and Plates Product Mix Existing)

Section	Sizes m.m.		
	Light Section	Medium	Heavy
Billets and Squares	40x40 to 60x60	80x80	100x100 to 130x130
Bars (R.C.) and Rounds	13.16.19	-	50 to 125
Flate bars and Sheet bars	6x30 8 and 10x40	-	30x120 8 to 12x300
Equal Angles	30x30 40x40 50x50	60x60 70x70 75x75	80x80 90x90/100x100 120x120/150x150
Unequal Angles	-	-	50x100 80x120 100x150
Channels	-	80.100	120.140.160 200.260
I Beams	-	120	140 160 200 260
Rails	-	-	18.37.52
Sleepers	-	-	(For Rails) 47 52 54
Fish Plates	-	-	(For Rails) 47.52.54

Rc.Reinforced Concrete bars

Rails identified in kg per metre

Sleepers for rails 18 kglm are also produced but by cold forming

	Sizes m.m.		
	Thickness	Width	Length
Plates	5 to 100	1250.1500	3000.6000

PRODUCTION CAPACITIES OF EGYPT (to be achieved by 1987)

(Sections and Plates Product Mix Future)

Sections	Sizes m.m.		
	Light Section	Medium	Heavy
Billets and Squares	20x20 to 30x30	40x40 to 80x80	100x100 to 130x130
Bars (R.C.) and Rounds	13,16,19,22	40,45,50 60,65,70	80 to 130
Flate bars and Sheet bars	6x30, 8 and 10x40	8x50	30x120 8 to 12x300
Equal Angles	25x25 30x30 40x40	50x50, 60x60 70x70, 75x75 80x80	90x90, 100x100 120x120, 150x150 180x180, 200x200
Unequal Angles	-	-	50x100 80x120 100x150
Channels	-	80,100	120,140,160 200,220,240 260
Beams (IPE)	-	-	140 to 400
" (IPB)	-	-	140 to 200
Rails	-	18	37,52
Sleepers	-	-	47/52,54
Fish plates	-	-	47,52,54

Plates	Sizes m.m.		
	Thickness	Width	Length
	50 to 100	1250, 1500	3000-9000

4. RECOMMENDATIONS FOR ACTION FOR THE DEVELOPMENT OF THE IRON AND STEEL INDUSTRY IN AFRICA, IN INTERCONNECTION WITH THE DEVELOPMENT OF THE AFRICAN RAILWAYS

In making recommendations for the development of the iron and steel industry in African Countries, one is of course, conscious of the fact that such recommendations cannot be regarded as all embracing in absolute terms. The endeavour is to focus attention on some of the problems and factors that are of critical value for the development of the iron and steel industry and seek to find pragmatic ways to tackle them.

(a) The establishment and growth of the steel industry are based on a complex network of project activities; some of the latter must precede the actual establishment of the steel industry, others have to be undertaken concurrently with the installation of the industrial plant and some perforce follow the commissioning and operation of the steel plant itself.
Thus techno-economic feasibility studies must precede the establishment of the steel industry; these studies comprise a vast spectrum covering inter alia the evaluation of raw materials and energy resources, technological process routes and choice of appropriate technology, plant layout and services, market demands and choice of product-mix, capital and production costs and financing of the industry, technical trained manpower and efficient business management, steel plant maintenance and infrastructure, etc. All such studies must be undertaken in advance of the establishment of the iron and steel industry such as at a green field site.
The steel plant's installation requires another set of co-ordinated activities concerning inter alia civil works and foundations, structural work and foundations, structural work and assembly, provision of utilities and services, commissioning of the plant units and operational trials.
The steel industry's practical operations themselves call for another set of well planned and co-ordianted activities covering the actual production of ironand steel and the product-mix based on maximum capacity utilization and adherence to optimum production norms and operational costs.
In all these fields, comprehensive planning and planned action are essential to maintain a chain of inter-related activities in order to get co-ordinated results. The African countries, like any other country, developed or developing, have to plan for the steel industry and its growth to optimum targets and endeavour to link the steel industry to

overall economic development of the country; the objectives being to make the fullest possible use of the natural resources and talents.

(b) In preparing the economic development plans, including those for the iron and steel industry, the need will inevitably arise to formulate the overall strategy for the growth of the iron and steel industry, and prepare a Master/National Plan for the iron and steel industry in the individual countries and regionally co-ordinate these Master Plans as pragmatically as possible.

(c) In the wake of long-term planning and preparation of Master Plans of the steel industry, the need to develop technical consultancy services and establish a base for indigenous technical designs and project engineering services, will be felt for the iron and steel industry and this will, of course, be a long-term strategy to be recommended to the African world.

The technical consultancy organization for the iron and steel industry will inter alia provide the following services to the latter:

(i) pre-feasibility and feasibility surveys and reports;
(ii) techno-economic project evaluation;
(iii) detailed project reports and engineering;
(iv) plant and equipment specifications;
(v) detailed layout, utilities and services;
(vi) materials balance and cost analyses;
(vii) capital costs and investment potentials;
(viii) production cost analyses and profitability;
(ix) market studies and demand projections;
(x) mode of financing and methodology of project implementation;
(xi) civil works and foundation analyses;
(xii) installation of plant and services;
(xiii) commissioning and plant running;
(xiv) overall plant operations and unit production including ancillary services;
(xv) training services and expatriate expert services.

The technical consultancy services will provide comprehensive services in the above fields for the iron and steel industry from a green field site to full operations of the steel plant, covering the entire gambit of technical self-sufficiency.

(d) The strategy for steel development would also entail the evaluation of schemes to maximum the socio-economic benefits of the steel industry; in other words, social cost analysis is recommended to be studied in order to convince the steel industry's critics who continue to maintain that the steel industry is too highly capital intensive and uneconomic for developing countries to project and further that the developing countries can buy all the steel in the world markets; but at what cost and at whose cost - these questions are mostly ignored. It is therefore recommended:

that the economic appraisal of the steel industry in the African countries (and developing countries) should not be undertaken in isolation or on absolute terms but on a national basis; the steel industry providing the basic raw materials (s eel sections, rails, profiles, rods, bars, plates, sheets, structurals, to name a few) for the light, medium and heavy engineering industries (transport - rail, road and shipping, consumer products, bridges and buildings, tools and machines) and so on. Apart from providing a main sinew for industrial development, the economic growth of the country is promoted through the training of technical manpower, technicians and skilled workers and of business managers. True, the quantitative measure of such benefits can be mostly qualitatively measured and assessed nevertheless. There now exists appropriate methodology to undertake social cost analysis and benefits of the steel industry and project them quantitatively to discerning planners and investors.

(e) It is also recommended that studies on the sectoral steel demand on a national and regional market basis should be sponsored for African countries (OAU). These studies will provide to the planners with the category-wise steel demand, based on the steel consumer industries. The value of these studies on national and regional basis is important to the African steel industry as a whole; more so, in view of the diversity of steel product-mix and the category-wise demand of steel in individual countries. The iron and steel in individual countries may be inhibited by the limited domestic markets and therefore, the possibilities of developing sub-regional markets and co-operation should be pragmatically studied in order to counteract the effects of the national market constraints.

(f) It is also recommended that co-operation amongst African countries (OAU) should be examined and promoted in the following specific areas:

(i) Interchange and supply of raw materials

African countries (OAU) should take steps to promote the interchange of raw materials (high-grade iron ores/pellets), directly reduced sponge iron, etc. on a mutually advantageous basis. For example, high-grade pellets from Morocco (RIF Mines in North Morocco) could be exported to Alexandria in ARE; the latter could from its projected DR sponge plant, export highly metallized sponge to Morocco for its new steel plant's electric arc furnaces. Identical bi- and multilateral exchange of raw materials, sponge and steel is strongly advocated amongst African countries of OAU.

(ii) Interchange of metallurgical know-how, expertise and consultancy services amongst African countries

A developing country within or outside Africa which has attained high standard metallurgical expertise, technical know-how and consultancy services, could assist another developing country lacking such specialization. This type of interchange can be promoted through governmental or private action.

(iii) Interchange of steel plant and equipment manufactured indigenously

A developing country within Africa or outside which has set up technical design and manufacturing facilities for the fabrication of iron and steel plant equipment and machinery can supply them to another developing country lacking corresponding design and manufacturing capabilities; such exchanges can be promoted through bi- and multilateral trade in raw materials, fuels, finished steel products or semis, on mutually beneficial terms.

(iv) Interchange of trained manpower and business management

Some developing countries have achieved high standard business management and executives and have trained personnel (operational and administrative) for the iron and steel industry. They can assist other African developing countries in training of plant managers and executives, steel plant operators, skilled workers, technicians and trouble shooters at various levels. Foremen, superintendents, supervisors, etc. are being trained in some developing countries. Additionally, the provision of such short- or long-term expatriate staff and trained personnel can be mutually arranged amongst the developing countries through mutually acceptable terms.

(v) Interchange of capital investment, equity partnership and sharing of financial resources amongst African countries

Developing countries relatively well endowed with capital resources including foreign exchange while lacking raw materials could assist others in Africa through joint capital investment, equity participations and formulation of joint Consortia; long-term loans and bilateral financial aid may also be arranged.

(vi) Interchange of trade and complementarity of production

Developing countries in Africa can establish mutually beneficial interchange of trade in finished steel end-products and semis (billets, blooms and even steel ingots, etc.) and market arrangements, so that complementarity of their efforts may lead to mutual gain.

On the basis of the above guidelines, it is recommended that specific project studies should be sponsored for technical co-operation and assistance amongst developing countries themselves. Plans for bi-lateral and multilateral iron and steel industry development based on technical co-operation and assistance amongst African countries themselves should be promoted.

(g) Production of sponge iron using high-grade iron ores/pellets and natural gas

Several African countries such as Nigeria, Algeria, Gabon amongst others, have good resources of natural gas and have also fairly good reserves of iron ores. It is strongly recommended that industrial scale production of highly metallized sponge should be taken up in African countries based on proved gaseous DR processes (HYL, Midrex, etc.). It is necessary to pelletize the iron ore fines with or without prior beneficiation as appropriate, and set up pelletizing plants; the high-grade pellets will provide the feed to the DR sponge plants and also an added value product for export. It is recommended that a Master Plan should be prepared for the African countries for the establishment of sponge iron plants in African countries based on the use of high-grade African iron ore fines pellets and natural gas resources. The highly metallized sponge could be exported with advantage outside Africa as also mutually traded amongst the African countries themselves on barter or cash basis. UNIDO can assist in the preparation of the Regional Sponge Master Plan for Africa.

(h) Production of alloy, tool, special and stainless steels in African countries

The ratio of alloy, tool, special and stainless steel output to that of mild and plain carbon steels is normally between 5-15%. In African

countries (OAU) there is practically no production of alloy, tool, special and stainless steels except in the ARE in a small way. It is highly important to plan the production of alloy steels on a national and regional co-ordinated basis. National and regional Master Plans should be prepared for the production of alloy, tool, special and stainless steels in the Africal countries (OAU); UNIDO can promote the preparation of such Master Plans on request by the countries concerned under their respective Country Programmes for UN technical assistance.

(i) The production of ferro-alloys and steel plant refractories in African countries

There is very little production of ferro-alloys and steel plant refractories in African countries (OAU). It is strongly recommended that techno-economic feasibility studies should be undertaken with UNIDO assistance for the production of ferro-alloys and steel plant refractories in African countries (OAU); these projects are of direct and indirect value to the iron and steel industry irrespective of the latter's establishment on a national or regional basis. The production of ferro-alloys should cover ferro-manganese (different grades), ferro-silicon, ferro-chrome (different grades of high and low carbon ferro-chrome), ferro-vanadium, etc; the steel plant refractories should include acid, basic and neutral refractories, e.g. high silica bricks, magnetite and dolomitic refractories, chrome-magnesite and carbon blocks, etc. A beginning has to be made in these fields.

(j) Iron and steel industry documentation and statistical data for African countries

The importance of documentation, dissemination and cataloguing of technical information and data pertaining ot iron and steel industry and technology is obvious; however, statistical data concerning iron and steel industry in African countries are not readily and fully available. A good start has been made by the Arab Iron and Steel Union and IDCAS (Industrial Development Centre of Arab States). A centralized technical data bank for the African countries (OAU) will be most useful to the latter.

(k) Standardization of steel products in African countries

It is never too early or late to study the standardization of multiple grades of plain carbon and mild steels as also of alloy, tools, special and stainless steels. Unified and mutually accepted standards (standard

specifications) will greatly facilitate mutual co-operation and trade amongst African countries (OAU). The current practice is to apply standards and relevant specifications as formulated in developed countries (ASTM, BSS, etc.) in African countries. Whilst this may appear inevitable, sooner or later, African standards have to be prepared, accepted and applied in practice. It is strongly recommended that action in these fields should be initiated and UNIDO can assist in undertaking such work on request of the countries concerned.

(1) Manpower and training of steel industry personnel for African countries

The training of personnel, skilled workers and technicians, foremen at operational levels and of business management executives and managers, it is strongly recommended, should receive concerted attention of African countries (OAU). This subject is of short-term and long-range importance. Very little appears to have been done in these fields except possibly on an ad-hoc manner in a few African countries. A review is also recommended of the educational and vocational training facilities in African countries (OAU) with a view to identify the capacity, future potential and types of technical educational facilities available in African countries. The need to do so is urgent.

It is emphasized that in the above technological training and industrial fields relating to the iron and steel industry, the process of study, survey and examination is self-generating giving rise to fresh issues, connected with the continuous growth and expansion of the iron and steel industry. An open mind will need to be kept on new issues and dimensions in order to rationally study the individual factors and needs of developing African countries and co-ordinate them on a regional platform. The importance and value of such national and regional studies and surveys of basic issues and plans cannot, therefore, be over-emphasized.

In conclusion, it is stressed that dogmatic approaches should be avoided in the establishment of the iron and steel industry in developing countries. Whilst the applications of the latest technological innovations, automation and computerized operations in developing countries are rightful ambitions and objectives, nonetheless the applications of fully appropriate technology should be encouraged depending upon the conditions and environments in each case and country.

Some of the areas in which co-ordinated action will be required by the African countries are the following:

i) raw materials development
ii) economic evaluation and strategy for development
iii) infrastructure and manpower
iv) market studies and projections including statistical data (home and export markets)
v) techno-economic feasibility studies including site selection studies
vi) detailed project reports covering project engineering.

5. CONCLUSIONS AND RECOMMENDATIONS

As it was mentioned above, that the iron and steel industry is a capital intensive industry and there are several approaches to make the most effective use of capital.

(A) Existing plants

(1) To rehabilitate and increase the capacity of the existing iron and steel plants which was established since many years as the case in Egypt, Algeria and Zimbabwe, revise the product mix of the recent plants as the case in Nigeria.
The target is to produce steel materials needed for the railway requirement of the sub-region.

(2) To utilize the existing capacities of the rolling stock fabricating plants in some countries to supply the requirements of the railway in the sub-region like the plant in Zimbabwe which can supply the requirements of some of the countries in the Eastern and Southern region and the plants in Egypt and Algeria which are able to supply the requirements of the countries in the North region or the central region.

(3) Utilizing the existing capacities of the railways maintenance workshops which after additng some equipment and machinery can manufacture some of the rolling stock as the case of railway maintenance shop in Kenya.

(b) New Plants

(1) In establishment of iron and steel plants the approach of downward integration is preferable starting with production units which are

single processes delivering a saleable product. In this approach the primary conversion units to produce pig iron and crude steel are deliberately postponed but planned for in the overall facilities. Generally, the production of rolled products from imported billets or slabs are considered to be merely an entry into product sales than steel production proper.

(2) The deliberate delay of the iron and crude steel capacity after the rolling mill has been commissioned and operated for a time corresponds to the natural evolution of the iron and steel industry. It is important to stress that primary conversion is fairly capital intensive and in cases where there is initial crude steel capacity, this stage of iron and steel industry development requires more capital than all other stages. An important question when planning for an expanded steel production is the economic size of the plant in question. It is recommended to have the smallest size that can give reasonable economy under prevailing conditions. Since trade within the sub-regions is expected to be an important strategy in the development of the iron and steel industry, it is essential that the iron and steel technology employed is chosen with great care. In particular, the technologies to be considered include:
Iron and steel,direct reduction, steel making, continuous casting and rolling and fabrication mill technologies. Due to the enormous effect of choice of technology on production costs and price and quality competitiveness of iron and steel products, it is highly recommended that the countries of each sub-region seriously consider close collaboration and joint action in the search, evaluation and negotiation for the most modern and efficient, available and tried technology and be ready to pay appropriate prices to ensure that products from their national steel plants as well as any sub-regional one are both price and qualitatively competitive. So it is recommended in case of establishment of new integrated plants, it must be on the basis of sub-regional project and all the technical aid and assistance given by the UNIDO or other organization for the studies must be for sub-regional projects and in co-operation with ECA.

(3) In planning to put new rolling stock factories in the sub-regions, the feasibility studies must be done on the basis of sub-regional projects, whether the study is done by UAR or ECA or any other agency as the case of the West African Economic Community (CEAO).

(4) Other engineering projects for railway requirements as springs, axles and wheels, bolts and screws, welding electrodes, must be studied on the same basis.

1. TRACKS

—Characteristics of rails and tracks
—Length of lines and tracks
—Type of Signalling

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Name of Railway	Track Gauge mm.	Weight of Rail Kg/m. (1)	Axle Load (T)	LENGTH OF LINES (Km.)						LENGTH OF TRACKS (Km.)						
				Electrified		Non Electrified		Total Km. cols. 5to8	Ballasted Km.	Electrified		Non Electrified		Total Km. Cols. 11to14	Ballasted Km.	Type of Signalling
				Single Track	Double Track	Single Track	Double Track			Single Track	Double Track	Single Track	Double Track			
								NORTH AFRICA								
SNTF	1,435 1,055 1,000	46		299		2,350 1,263		2,649 1,263								
ER	1.435	47/54	22		25	2,928	952	3,905	3,905		50	2,928	1,904	4,882 (2)	4,882	Electrical & Mechanical
ONCF	1.435	33/54	22	549	163	1,056		1.768	1.768	549	326	1,056		1.931	1.931	Electrical & Mechanical
SRC	1,067					4,784.1		4,784.1				5,495.9		5,495.9		
SNCFT	1.000 1.437	25/36 30/46	16 18			1,282 414	18	1,318 414	1.318 414			1,476 479	18	1,512 479	1,512 479	
								16101 CENTRAL AFRICA								
ANGOLA	1.067	13/60	13					3.613								
RNCFC	1.000	26/36	14			1,164	4	1,168	1,168			1,360	8	1.368		Simple panels
CFCO	1,067	30/44	20			(3) 792·5	2.5	795	795			(3) 1.039.6	2.5	(3) 1,042.1	(3) 1,042.1	Mechanical and Electrical
OCTRA	1,437	50	28			90		90	90			130		130	130	
SNCZ	600 1,000 1.067	9/32 24.4 24.4/40	8 12 15	858		1,023 125 2,715		1.023 125 3,573		861		1,048 139 4,179		5.366		Mechanical

1. TRACKS

—Characteristics of rails and track
—Length of lines and tracks
—Type of Signalling

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
				LENGTH OF LINES (Km.)						LENGTH OF TRACKS (Km.)						
				Electrified		Non Electrified				Electrified		Non Electrified				
NAME OF RAILWAY	TRACK GAUGE mm.	WEIGHT OF RAIL Kg/m. (1)	AXLE LOAD (T)	Single Track	Double Track	Single Track	Double Track	TOTAL Km. cols. 5 to 8	BALLASTED Km.	Single Track	Double Track	Single Track	Double Track	TOTAL Km cols. 11 to 14	BALLASTED Km.	TYPE OF SIGNALLING
								WEST AFRICA								
RAN	1,000	25/36	15			1,147		1,147	1,120			1,144	19	1,163	1,157	Mechanical
OCBN	1,000	22/30	13.5			579		579	-			655		655		
GRH	1,067							925								
ONCFG	1,000							662								
LAMCO	1,435							270								
REFM	1,000	20/30	15			641		641	641			702		702	702	Mechanical
SNIM	1,435	54	25			650		650	650			738		738		Radio Control of trains
NRC	1.067	30/40	18			3.523		3,523				4,846		4.846		Predominantly Mechanical (2)
RCFS	1.000	36	15			964	70	1.034				1.116	70	1.186		Fixed signals
CFT	1.000	33/36	12.5			442		442				497		497		

I. TRACKS

—Characteristics of rails and tracks

—Length of lines and tracks

—Type of Signalling

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Name of Railway	Track Gauge mm.	Weight of Rail Kg/m. (1)	Axle Load (T)	LENGTH OF LINES (Km.)					LENGTH OF TRACKS (Km.)							
				Electrified		Non Electrified		Total Km. cols. 5–8	Ballasted Km.	Electrified		Non Electrified		Total Km. cols. 11–14	Ballasted Km.	Type of Signalling
				Single Track	Double Track	Single Track	Double Track			Single Track	Double Track	Single Track	Double Track			
								EAST	AFRICA							
CFE	1,000	30/20	14					781								
UR	1,000					1,265		1,265								
RNCFM	1,000	25/37	14			883	5	888				156		1,044		Electrical & Mechanical
MR	1,067	30/40	15			556		556	351			614		614	351	Token
CFM	1.067 762	22.5/54 15/24	12/20 5.5			2,427 90	30	2,457 90	2,417			2,965 140	30	2.995 140	2,905	Electrical
SR	1.067	40	16			220		220	220			270		270	270	CTC
Tazara	1,670	45	20			1.860		1.860	1.860			2.044		2,044		
ZR	1,067	30/45	18					1.104								

9221

3. ROLLING STOCK
3-2. TRAILLING STOCK
3-2-1. PASSENGERS

(Number. Availability, Number of Seats at the end of financial year)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Name of Railway	COACHES										RAILCAR TRAILERS						
	Number				Number of Seats							Number of Seats					
	Ordinary coaches and vans	Sleeping cars	Dining cars	Total cols. 2, 3 & 4	1st Class	2nd Class	Other Classes	Total cols. 6, 7 & 8	Seats	Beds	Number	1st Class	2nd Class	Other Classes	Seats	Beds	Availability %
NORTH AFRICA																	
SNTF				475 (1)				31.894 (1)									
ER	1,394	59	13	1,466	3,611	24,976	85,724	114,311	114,311	1,284	234	1,974	6,880	4,320	13,174		70%
ONCF	394	7		401	3,042	10,823	4,558	18,423	18,353	70							
SRC	441	33	12	486	1,602	3,265	20,142	25,009	24,613	396	9		96	750	846		80%
SNCFT	146	2	2	150	1,295	4,684		5,979	5,979	92	58	1,028	5,130		6,158		88.4%
								195616									
CENTRAL AFRICA																	
ANGOLA																	
RNCFC	42	5	3	50	135	2,076		2,211	2,211	104	57	140	3,768		3,908		85%
CFCO	35	1	2	38	280	864	1,634	2,778	2,530	14	40	225	2,260		2,215		79%
OCTRA	16			16		800		800	800								100%
SNCZ	129	68	22	219	1,128	1,624	7,994	10,746	8,906	1,840	15	910	92		1,002		40%

3. ROLLING STOCK

3-2. TRAILLING STOCK

3-2-1. PASSENGERS

(Number, Availability, Number of Seats at the end of financial year)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Name of Railway	COACHES										RAILCAR TRAILERS						
	Number				Number of Seats							Number of Seats					
	Ordinary coaches and vans	Sleeping cars	Dining cars	Total cols. 2, 3 & 4	1st Class	2nd Class	Other Classes	Total cols. 6, 7 & 8	Seats	Beds	Number	1st Class	2nd Class	Other Classes	Seats	Beds	Availability %
							WEST AFRICA										
RAN	129	12	6	147		9,734		9,968	9,968	234	27		1.886		1,886		98.7%
OCBN	11			11		120		120	120	18	18		1.076		1,078		90%
GRH				182													
ONCFG				20													
LAMCO																	
RCFM	26	4	1	31	42	790		888	888	64	16	204	932		1.136		73.7%
SNIM	8			8	12	168		180									
NRC	467	286	52	805	1,088	1,602	30,090	32,780	29,776	3,316							
RCFS	110 (1)	4	2	116	210	2,956	52	3,218	3,166	60	28	48	1,598	109			
CFT	34			63							11						

3. ROLLING STOCK

3-2. TRAILLING STOCK

3-2-1. PASSENGERS

(Number, Availability, Number of Seats at the end of financial year)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	COACHES										RAILCAR TRAILERS						
NAME OF RAILWAY	Number				Number of Seats						Number	Number of Seats					Availability %
	Ordinary coaches and vans	Sleeping cars	Dining cars	Total cols. 2, 3 & 4	1st Class	2nd Class	Other Classes	Total cols. 6, 7 & 8	Seats	Beds		1st Class	2nd Class	Other Classes	Seats	Beds	
CFE							EAST AFRICA										
KR	97	67	17	181	627	1.422	8.084	10.133	10.13.	1.835							
RNCFM	29			29	381	2.466		2.847	2.027		42	531	4.020		3.068		95.6 %
MR	30	2	1	33		88	2.788	2.876	2.876								94.. %
CFM	187				663	2.414	13.028	16.105									80 %
SR																	
TAZARA	44	46	10	100	364	1,584	3.264	5.212	3.264	1.948							75 %
ZR	132	6	12	150	1.040	3.240	640	4.920	5.046	132	6			360			

3. ROLLING STOCK

3-2. TRAILING STOCK

3-2-2. GOODS

(Number. Net Weight. Availabiiity at the end of financial year)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Name of Railway	Covered Wagons		Flat Wagons		High-sided Open Wagons		Other Wagons		Privately-owned Wagons		Total Number cols. 2, 4, 6, 8 & 10	Total Net Weight (T) cols. 3, 5, 7, 9 & 11	Availa-biiity %
	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)			
						NORTH AFRICA							
SNTF											11.049	314,139	
ER	6.948	76,870	500	35.990	6.359	180.781	2.813	62.205			16.620	355.846	85%
ONCF	2.337	55.384	2,099	51.533	2,087	46.182	2.897	122.491	554	18.066	9.974	293.656	
[illegible]C	3.523	105.562	218	6.658	979	28.739	1.283	34.350	658		6.661	175.809	92%
[illegible]FT	944	13,142	1,035	20,235	643	8.710	2.746 (1)	61.875	103	2.680	5.471	106.642	93.47%
						CENTRAL AFRICA					49775		
ANGOLA													
RNCFC	542	16.400	551	24.750	95	3.220	183	5.630	130	4.480	1.501	54.480	90%
CFCO	612 (2)	24.523	664	32.590	219	8.250	239	6.732	159	7.063	1,893	79.158	85.2%
OCTRA	12	660	300	20.4000	1	50	8	485			321	21.595	100%
SNCZ	2.144	74,219	1,893	70.834	530	18.884	1.032	34.455	284	9.656	5.883	208.048	56%

9598

3 ROLLING STOCK

3-2. TRAILING STOCK

3-2-2. GOODS

(Number. Net Weight, Availability at the end of financial year)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Name of Railway	Covered Wagons		Flat Wagons		High-sided Open Wagons		Other Wagons		Privately-owned Wagons		Total Number cols. 2, 4, 6, 8 & 10	Total Net Weight (T) cols. 3, 5, 7, 9 & 11	Availa-bility %
	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)			
						WEST AFRICA							
RAN	661	19,740	170	4,187	211	6.195	51	1.144	107	3.520	1.200	34,786	
OCBN	210	6.046	91	2.428	15	715	27	575	13	210	356	9,974	94.7%
GRH													
ONCFG													
LAMCO													
RCFM	262	8.299	25	925	49	1.715	34		10		380		89%
SNIM			82	5.248			1.070 (1)	85.154			1.152	90,402	85%
NRC	3.606	99.912	45	1.170	372	9.435	2.625	69.709	590	17,182	7,257	196,925	
RCFS	479	13,470	58	1.334	149	3.675	39	330	180	6.287	905	25,096	
CFT	199	2,738	94	2.942									

3. ROLLING STOCK

3-2. TRAILING STOCK

3-2-2. GOODS

umber, Net Weight, Availability at the end of financial year)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
NAME OF RAILWAY	Covered Wagons		Flat Wagons		High-sided Open Wagons		Other Wagons		Privately-owned Wagons		Total Number cols. 2, 4, 6, 8 & 10	Total Net Weight (T) cols. 3, 5, 7, 9 & 11	Availability %
	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)	Number	Net Weight (T)			
						EAST AFRICA							
CFE													
KR	3,246		928		825		1,634				6,633		
RNCFM	545	14,475	257	6,736	92	2,760	75	2.526	78	2,360	1.047	28,857	97.3%
MR	346	11,387	22	573	141	6,107	247	8.362			756	26,429	95.4%
CFM	1,468	50,254	312	10.435	5.335	214.200	542	16,329			7.657	291,218	86%
SR	23	460			535	9.095	209	3.971	20	400	787	13,926	95%
TAZARA	523	15.690	892	44.600	400	20.000	285	5.161			2.100	85.601	97.5%
ZR	311	9.952	30	1.200	4.429	193.721		1.207	40		4.810	206.080	

23790

3. ROLLING STOCK

3—3. CONTAINERS

(Types, Sizes. Number and Traffic)

1	2	3	4	5	6	7	8	9	10	11
Name of Railway	Types	SIZES			NUMBER		TRAFFIC (in thousands)			
							National		International	
		Length (mm)	Width (mm)	Height (mm)	Owned by the Railway	Privately owned	Tonnage	T.K.	Tonnage	T.K.
					NORTH AFRICA					
SNTF										
ER										
ONCF	SCIFCT SNCF	2.170	1.500	1.635	190					
	Bloc tube	2,310	2.200	1.900	57					
SRC										
SNCFT ..	42	3.032	2.032	2.000	129					
	C	1,900	1,100	1,425	37					
	SPB	2,098	1.000	1,500	20					
	SP	2,006	1,604	1,450	35					
	ISO	5,695	2.078	2,078	53					
					CENTRAL AFRICA					
ANGOLA ..										
RNCFC ..	(1)	ISO								
CFCO										
OCTRA ..										
SNCZ										

Table 2 Mineral Resources of Africa/Production, 1980, tonnes

	Algeria	Angola	Botswana	Burundi	Central African Rep.	Cameroon	Congo	Cape Verde Isl.	Egypt	Ethiopia	Gabon	Ghana	Guinea	Kenya	Ivory Coast	Lesotho	Liberia	Libya	Madagascar	Mali	Mauritania	Mauritius	Morocco	Mozambique	Namibia	Ni
Alumina													708,000													
Aluminium (thousand tons)						43			120			188											349		2,000	
Antimony (tons)	-																									
Arsenic (White)																								800		
Asbestos									230					6,647									318,000			
Barium (tons)	91,000								3,000			225	11,739											...		
Bauxite																							18,100	1,500		
Bentonite and Fuller's Earth (tons)	41,000								5,200																70	
Cadmium	150																		146,529							
Cadmium Ores and Concentrates (tons)																							880,000	408,000		
Coal (tons)			371,395																				1,000			
Cobalt (metal content - tons)			226																				8,400	-	39,200	
Copper (Mine Prod.)	200		15,354			-															-				40,000	
Copper (Smelter Prod.)																									1,340,000	
Diamonds		1,500,000	3,146,000		279,000							1,200,000	84,000		40,000	53,714	300,000									
Diatomite	3,600								100					1,677												
Feldspar									3,600					367										-		
Fluorspar									680					93,378									84,400			
Gold (Kilogram)		...		4		5	220			280	28	10,937		4			140		4	43	-					
Graphite	200,000	25,000							690,368										9,906							1,80
Gypsum														-				...			14,000					
Iron Ore	3,500	...							1,870								17,481				8,900		78			
Pig-Iron	580																									
Steel Ingots and Castings	500								760																	
Ferro Alloys									...																	
Kaolin	18,100			2,750					49,000	30,000			1,487						2,720				115,500		47,700	
Lead	2,400						7,000																40,300		42,700	
Refind Lead																									3,000	
Lithium																								-		
Magnesite																										
Manganese Ore									-		2,147,000	252,450											132,200			
Mercury	1,035,000																		1,642					200		
Mica																							500			
Nickel			15,442																				14			
Petroleum	51,560	7,610			2,790	3.130			31,200		8,880							86,020					80			
Natural Gas	14,600	...									...							...					18,824,200			
Phosphate Rock	1,025,400								658,000				-													
Platinum (Group Metals, Kilograms)										4																
Potash							-																			
Rare Earths				...																						
Salt	172,000	50,000						...	699,000	106,000		50,000	47,016				10,000	30,000	5,000		6,000		104,000	28,000		
Sillimanite																										
Silver	2,500																						10,000			
Sulphur Pyrites									3														60			
Talc									4,400																	
Tantalum (Columbium)																								-	1,000	
Tin (Mine Prod.)						24																				
Tin (Smelter Prod.)																										

Source: World Mineral Statistics, 1976-1980, Production/Exports/Imports (Institute of Geological Sciences, Natural Environment Research Council, London, Her Majesty's Stationary Office, 1982).

Table 2 Mineral Resources of Africa/Production, 1980, tonnes

Guinea	Kenya	Ivory Coast	Lesotho	Liberia	Libya	Madagascar	Mali	Mauritania	Mauritius	Morocco	Mozambique	Namibia	Niger	Nigeria	Rwanda	Senegal	Sierra Leone	South Africa	Sudan	Swaziland	Tanzania	Togo	Tunisia	Uganda	Zaire	Zambia	Zimbabwe
708,000																		87									
										549		2,000						13,013									150
																											79
	6,647										800							776,734		32,833							230,949
										318,000							674	2,635		-			26,950				195
11,739											...																
										18,100	1,500					3,978		52,535									
												70													168	-	
						146,529												3,414,410	23,000								352,475
										680,000	408,000			612,802				115,119,974		175,989	4,250				138,000	368,799	3,133,036
										1,000								200,683							14,700	3,310	
								-		8,400	-	39,200						185,800						-	439,700	609,935	24,901
												40,000												-	425,700	601,348	26,700
84,000		40,000	53,714	300,000								1,560,000					392,018	6,321,682			289,876				10,233,000		
	1,677													5,000				584									
	367																	52,247								475	1,263
	93,378										-							322,718									-
	4			140		4	43	-		64,400					15			673,786					39,481		1,343	237	11,443
						9,906												-									7,385
	-				...			-14,000					1,800					452,490	10,000		8,119		214,910			-	
				17,481				8,900		78								26,312		-			389				1,622
																		7,200					140				93
																		9,000					182				800
																		1,577,950									221,910
1,487						2,720				115,500		47,700		...				137,954		- 7,434							4,450
										40,300		42,700		100				56,059					8,310			14,131	
											-	3,000		...									19,193			10,047	
																		39,975									21,030
										132,200								5,695,426							16,586		78,217
						1,642					200							2,528	1,500	3							1,022
										500								25,700									15,075
					86,020					14				100,286									5,600	1,000			
					...					80				1,343				3,185,000		2,930,000			353				
-										18,824,200						1,372,603							4,301,907	-			130,337
																		192,800									
														20											31		
47,016			10,000	30,000	5,000		6,000	104,000	28,000					227,000		140,000		567,000	82,000	36,734			436,316				
																		121,317									
														47,000				97,213					7,332		85,003	23,752	29,681
										10,000								302							30	101	29
										60								14,366									456
														550 60											40		41
								-	1,000		96			2,527 1,600				2,913							3,139		934
														2,684				1,100							300		918

IRON AND STEEL INDUSTRY IN THE AFRICAN COUNTRIES

IRON AND STEEL INDUSTRY IN AFRICA 4/

No.	Countries 1/	Population (years) (Rounded off figures) 1972/73 (IBRD) x 1000	1985 (UN)	2000 (WIS)	Critical Raw Materials 3/ Iron Ores: Reserves million tons	Fe	SiO_2	Al_2O_3	Mn	P	S	Others	Remarks
1.	Nigeria	70,000	85,000	105,000	206	45							
					80	32							
2.	A.R. Egypt	35,000	53,500	75,000	433	46	14			2-4	.6		
						50-59	2 - 9				1-9		
3.	Ethiopia	26,000	35,800	50,000		43	25				0.4		
					29	30/40	13/33						
4.	Zaire	20,000	25,800	34,000	5050	30 to 50	9				.1		
5.	Sudan	17,000	26,100	40,000	61	61							
6.	Morocco	16,000	26,800	41,000	149	43 -60	7- 10	1-6		.2+ 2.3	.01 to -1.5	0.01	14.6 BaO 2.2 CaO
					28						1.1	0.0	
7.	Algeria	14,000	24,000	38,000	1,580	40-56 49-56	3.8 4.9	- 4.3		2 -	- 0.8	-	3.4CaO+.1MgO .3MgO +.1Ti
8.	Tanzania	14,000	20,000	29,000	121	50. 30.				upto 11			TiO_2 13
9.	Kenya	12.000	18,000	36,500	27	60	5	-	-	0.2			
10.	Uganda	10,500	13,100	18,000	98	60 -67	1.1	0.05 -2.6					TiO_2 10-30
11.	Ghana	9,000	15,000	24,000	405	46 -51	3			1.0			
12.	Mozambique	8,000	10.900	14.000	261	52.4 to 67	1 to 24			.05	.02		
13.	Malagasy Rep.	7,400	10.800	16,000	251	25 to 46	1			.15	.3		
14.	Cameron	6,000	8,000	11,000	120	38				.08	.2		
15.	Angola	5,600	8,100	12,000	1100	62	3-8			.05	.03 -1.0		
16.	Upper Volta	5,600	7,700	10.500	50	58	2.2	1.5	.2	.06			V-0.3
17.	Ivory Coast	5,400	6,500	8,500	2,400	40 -46	39			.06	.01		
18.	Tunisia	5,300	8,500	13,000	75	54 58	4 4	.8 3.7	2 2	.03 .1	- -	0.5 CaO 0.3 CaO	
19.	Mali	5,300	7,600	11,000	69	64							
20.	Guinea (Z)	5,100	7,000	10,000	1544	52 -64	3 -24			.06	.1		
21.	Malawi	4,700	6,800	10,000									
22.	Zambia	4,500	7,000	10,000	346	40 -62	6 -20		1.8				
23.	Niger	4,300	6,200	9,500	680								
24.	Senegal	4,000	6,500	10,000	100	58	5			.03	.08		
25.	Rwanda	4,000	5,700	9,800									
26.	Chad	3,800	5,500	9,000									
27.	Burundi	3,500	5,300	8,300									
28.	Somalia	3,000	4,300	6,500	170	30 -32							
29.	Dohomey	2,800	4,100	5,500	290	50 -58	3 -16			.8	.04		
30.	Sierra Leone	2,700	3,800	5,800	200	60	6 -13			.01 -.03	.005		
31.	Libya	2,000	3,100	5,000	3525	50	6 -11	4.9	-	1.0			
32.	Togo	2,000	2,800	4,300	642	35 -40	20	16		.23	.05		
33.	Central African Rep.	1,700	2,100	3,000	-	-	-	-	-	-	-		
34.	Liberia	1,600	1,800	2,200	713	65,8	4.2	1.2	0.12	.03	.001		
35.	Mauritania	1,200	1,700	2,500	465	65	4-3	1.2	0.12	.03	.01		
36.	Congo (Braz.)	1,200	1,350	1,600	100	43	20						
37.	Spanish Sahara	-	56	65	150	54						Ti-14	
38.	Gabon	500	600	800	1,216	65	1.7	2		0.15	CaO -0.2		
39.	Swaziland	450	680	990	280	61	4.2		6.9 to 0.4				
40.	Gambia	380	514	750									
	Others	2,200	3,500	5,000	600								
	TOTALS	347,730	491,600	707,105									

No.	Countries 1/	Coal 2/ Reserves million tons	Quality	Oil million m^3	Gas billion m^3	Per capita steel consumption per year 1973 kg/ per capita	2000	Ingot Steel Production x 1000 tons kg/per capita 1973	1974	Ingot Steel Production x million tons Years 1980	1985	per year 2000
1.	Nigeria	350	non bituminous	2,400	1,136	1.4	28	15 (0.2 p.c.)	20	0.5	1.5	5.
2.	A.R. Egypt			100 (8)		28	200	340 (7 kg/p.c.)	350	3.	8.	15.5
3.	Ethiopia										0.5	2.
4.	Zaire	73	non bituminous	80						0.5	1.	3.
5.	Sudan		non								1.	3.
6.	Morocco	68 28	bituminous anthracite	180	40	22	150	5 (0.3 p.c.)	5		1.5	6.
7.	Algeria	20	SSR bituminous	7,550	2,960	70	440	395 (25 kg/p.c.)	410	2.	6.	15.
8.	Tanzania											1.
9.	Kenya					10	25	25 (2 kg/p.c.)	25	0.3	0.5	2.
10.	Uganda					15	100	15 (1 kg/p.c.)	15	0.5	1.5	2.0
11.	Ghana					1	25			0.1	0.2	1.
12.	Mozambique	700	non bituminous									
13.	Malagasy Rep.											1.
14.	Cameron											0.5
15.	Angola			192 (inclusive	28.4 Cabinda)							1.5
16.	Upper Volta											0.2
17.	Ivory Coast										0.4	1.2
18.	Tunisia	20	Lignite	160	28.4	60	400	87 (16 kg/p.c.)	90	0.3	1.5	4.
19.	Mali									0.3	0.6	1.
20.	Guinea (Z)											2.
21.	Malawi											
22.	Zambia	115	non bituminous									1.
23.	Niger											
24.	Senegal											1.
25.	Rwanda											
26.	Chad											
27.	Burundi											
28.	Somalia											
29.	Dohomey			832	213							
30.	Sierra Leone											
31.	Libya			4,864	781	138	800			-	2.0	5.
32.	Togo											
33.	Central African Rep.											
34.	Liberia					30	500			-	0.5	2.
35.	Mauritania										1.	2.
36.	Congo (Braz.)			800								
37.	Spanish Sahara											
38.	Gabon	5,022	non-bituminous	176	198	66	500				0.5	1.5
39.	Swaziland					1	200			0.2	.3	.45
40.	Gambia											
	Others											
	TOTALS							882 2.5kg p.c.	915	17 = 22 kg p.c.	28.0= 57 kg p.c.	79.85 = 80- 115 kg p.c

No.	Countries 1/	Raw Materials Poor (P) Iron Ores	Fair (F) Coal Coking	Coal Non-Coking	Good (G) Charcoal	Excellent (E) Oil	Gas	Present Sta Poor (P)	Fair (F)
1.	Nigeria	F	F	F	-	G	G	F	
2.	A.R. Egypt	F	F	F	-	F	F	-	F
3.	Ethiopia	F	F	F	F	F	F	F	
4.	Zaire	F	F	F	F	F	F	F	
5.	Sudan	F	F	F	F	F	F	F	
6.	Morocco	G	F	F	-	F	F	F	
7.	Algeria	F	F	F	-	G	G	-	F
8.	Tanzania	F	-	-	-	-	-	F	
9.	Kenya	F	-	-	-	-	-	F	
10.	Uganda	F	-	-	F	-	-	F	
11.	Ghana	F	-	-	F	-	-	F	
12.	Mozambique	F	-	F	-	-	-	F	
13.	Malagasy Rep.	F	-	-	-	-	-	F	
14.	Cameron	?	-	-	-	-	-	F	
15.	Angola	F	-	-	-	F	F	F	
16.	Upper Volta	F	-	-	-	-	-	F	
17.	Ivory Coast	F	-	-	-	-	-	F	
18.	Tunisia	F	-	-	-	-	-	F	
19.	Mali	F	-	-	-	-	-	F	
20.	Guinea (Z)	F	-	-	-	-	-	F	
21.	Malawi	F	-	-	-	-	-	F	
22.	Zambia	-	-	-	-	-	-	F	
23.	Niger	F	-	F	F	-	-	F	
24.	Senegal	F	-	-	-	-	-	F	
25.	Rwanda	F	-	-	-	-	-	F	
26.	Chad	-	-	-	-	-	-	F	
27.	Burundi	-	-	-	-	-	-	F	
28.	Somalia	F	-	-	-	-	-	F	
29.	Dohomey	F	-	-	-	-	-	F	
30.	Sierra Leone	F	-	-	-	G	F	F	
31.	Libya	F	-	-	-	-	-	F	
32.	Togo	G	-	-	-	E	G	F	
33.	Central African Rep.	F	-	-	-			F	
34.	Liberia	F	-	-	-			F	
35.	Mauritania	G	-	-	-			F	
36.	Congo (Braz.)	G	-	-	-			F	
37.	Spanish Sahara	F	-	-	-	F		F	
38.	Gabon	-	-	-	-			F	
39.	Swaziland	G	-	G	-			F	
40.	Gambia	F						F	
	Others	-						F	

1/ Excluding South Africa and Rhodesia

2/ There are no coking coal reserves in these African countries (excluding South Africa and Rhodesia) - Resources of anthracite to sub-bituminous coals are 7,000 m/tons

3/ Total reserves of iron ores in Africa (30-67% Fe) proved = 6,800 m tons/Potential unproved reserves iron ores = 24,500 m/tons; total = 31,300 m/tons

4/ All Metric Tons

AND STEEL INDUSTRY IN THE AFRICAN COUNTRIES

Per capita steel consumption per year		Ingot Steel Production x 1000 tons		Ingot Steel Production x million tons			Raw Materials						Present Status of Industrialisation				Prospective Iron and Steel Industry in the Year 2000				Remarks
				Years		per year	Poor (P)		Fair (F)		Good (G)	Excellent (E)										
1973	2000	kg/per capita					Iron Ores	Coal Coking	Coal Non-Coking	Charcoal	Oil	Gas	Poor (P)	Fair (F)	Good (G)	Excellent (E)	Poor (P)	Fair (F)	Good (G)	Excellent (E)	General Analyses based on resources (men and materials) for the Iron and Steel Industry: A to G represents the status of the Steel Industry of African Countries
kg/ per capita		1973	1974	1980	1985	2000															
1.4	28	Kg 15 (0.3 p.c.)	20	0.5	1.5	5.	P	P	P	-	G	G	P						G		(G) Iron and steel industry will be expanded to make Nigeria a leading steel producing in Africa.
28	200	140 (7 kg/p.c.)	350	3.	8.	15.5	P	P	P	-	P	P	-	P					G		(E) Iron and steel industry is being expanded and EGY will be a leading steel producer in Africa
					0.5	2.	P	P	P	P	P	P	P				P				Needs a small iron and steel industry
				0.5	1.	3.	P	P	P	P	P	P	P					P			" " " " " "
					1.	3.	P	P	P	P	P	P	P					P			Iron and steel industry needs top priority
22	150	5 (0.3/p.c.)	5		1.5	6.	G	P	P	-	P	P	P						G		(F) Morocco should have a medium sized steel industry in Africa.
70	440	395 (25 kg/p.c.)	410	2.	6.	15.	P	P	P	-	G	G	-	P					G		(E) Iron and steel industry's expansion is being given a top priority and Algeria will lead the African countries in steel production.
						1.	P	-	-	-	-	-	P					P			
10	25	25 (2 kg/p.c.)	25	0.3	0.5	2.	P	-	-	-	-	-	P					P			
15	100	15 (1 kg/p.c.)	15	0.5	1.	2.0	P	-	-	P	-	-	P				P				
1	25			0.1	0.2	1.	P	-	-	P	-	-	P				P				
							P	-	P	-	-	-	P				P				
						1.	P	-	-	-	-	-	P				P				
						0.5	P	-	-	-	-	-	P				P				
						1.8	P	-	-	-	P	P	P				P		G		
						0.2	P	-	-	-	-	-	P				P				
						1.2	P	-	-	-			P						G		
60	400	87 (16 kg/p.c.)	90	0.3	1.5	4.	P	-	-	-			P				P				(E) Tunisia will have a medium size steel industry in Africa
				0.3	0.6	1.	P	-	-	-			P				P				
						2.	P	-	-	-			P				P				
							-	-	-	-			P				P				
						1.	P	-	P	P			P				P				
							P	-	-	-			P				P				
						1.	P	-	-	-			P					P			
							P	-	-	-			P				P				
							-	-	-	-			P				P				
							-	-	-	-			P				P				
							-	-	-	-			P					P			
							P	-	-	-			P				P				
							P	-	-	-	G	P	P				P				
							P	-	-	-	-	-	P				P				
138	800			-	2.0	5.	G	-	-	-	E	G	P						G		(D) Iron and steel industry needs top priority. Libya will be a leading steel producer in Africa.
							P	-	-	-			P				P				
							P	-	-	-			P				P				
30	500			-	0.5	2.	G	-	-	-			P					P			(G) Liberia will have a medium size steel industry amongst the African countries.
					1.	2.	G	-	-	-			P						G		
							P	-	-	-	P		P				P				
							-	-	-	-			P				P				
66	500				0.5	1.5	G		G	-			P					P			
1	300			0.2	.3	.45	P						P				P				
							-						P				P				
		882 2.5kg p.c.	915	17 = 22 kg p.c.	28.0= 57 kg p.c.	79.85 = 80= 115 kg p.c															

a/tons